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THE NASA ROLE IN MAJOR AREAS OF HUMAN CONCERN

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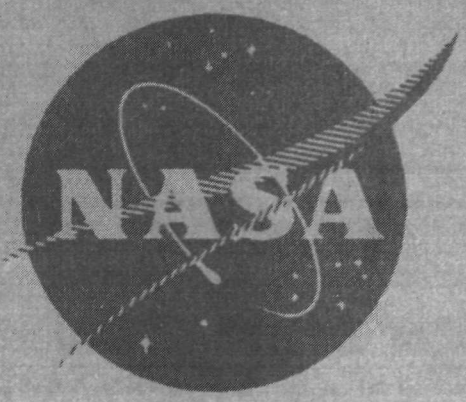
TRANSPORTATION



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THE NASA ROLE

IN MAJOR AREAS OF HUMAN CONCERN:

TRANSPORTATION

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PREFACE

Understanding the social significance of America's civilian aeronautics and space effort has become increasingly difficult during the past five years. Whereas the missions of the National Aeronautics and Space Administration once figured prominently in discussions of public issues, increased interest in other national priorities has come to compete with, and often to dominate, concern about those missions. The study which generated this presentation was undertaken to facilitate more thoughtful discussion of NASA's activities by exploring how the achievement of mission objectives has contributed to beneficial changes occurring in six areas of major national interest: communication, transportation, environmental quality, safety, health care and work.

This statement focuses attention on the area of transportation. After introducing some of the general factors that have affected progress in this area, NASA program elements are examined to illustrate relevant points of contact. Interpretive steps are taken throughout the statement to show a few of the more important ways people's lives have been affected as a result of the work of NASA and other organizations functioning in this area. The principal documents used and interviews conducted are identified after the conclusion of this statement.

This statement, it should be noted, is incomplete in many respects, primarily because it reflects only a small number of the technical, economic, and social forces affecting American life. Taken as a summary statement, however, it hopefully will provide a useful basis for better understanding NASA's role in the national attempt to upgrade the quality of transportation services.

TRANSPORTATION: IMPROVING THE ALTERNATIVES

At no time in the history of the United States has distance meant less than it does to contemporary Americans. An interesting indication of this fact can be found in the phenomenal growth of automotive travel.[1] The average American car owner drove approximately 10,000 miles last year; 50 years ago the typical American traveled about 1,640 miles annually, 1,300 miles of it on foot. Paved roads and streets have been added to the nation's landscape at the rate of 200 miles per day during the last 20 years. Much the same growth story can be told of other forms of transportation.[2] During 1970, air travelers logged over 100 billion passenger miles. In 1900, by contrast, man had not even left the ground in powered flight. Considering all vehicle modes of transportation, passenger miles traveled within the United States have been increasing at a rate six times faster than population for at least twenty-five years.[3]

Mechanized transportation is a recent achievement.

In a sense, the growth of American transportation has been haphazard since little effort has been directed toward the implementation of any overall plan for achieving balanced development. It wasn't until the U. S. Department of Transportation (DOT) was established in 1966 that the widely recognized need for forming and implementing a general transportation plan began to take shape.[4] Spearheaded by DOT efforts, new initiatives have been launched to solve the pollution, congestion and safety problems facing the cities, and to do this in such a way as to safeguard the beneficial advances that have occurred in the past.

DOT works toward solution of problems.

According to Robert Cannon, DOT's assistant secretary for systems development and technology, the country's aerospace program is providing major guidance in shaping transportation policy and practice for the future.[5] Emphasizing that many transportation problems have a basically technological character, Cannon says NASA's successful approach in the Apollo program demonstrates that large teams of highly skilled people can be organized to accomplish transportation objectives of great technical difficulty.

NASA's experience is of major assistance.

Admittedly, surmounting technological difficulties is only a part of the challenge in developing better transportation systems. Economic, social, and political problems are possibly even more demanding. Yet, NASA's work in three important problem areas--noise pollution, congestion, and aviation safety--are providing improvements and alternatives needed for a more satisfactory national air transportation system.

NASA solves noise pollution, congestion and safety problems.

Reducing Noise Pollution

Although the success of civil aviation has produced many benefits for the nation, this industry also is confronted with a number of serious problems that rapidly are growing more severe.[6] Public concern with noise, air and water pollution, and ecological disturbances has increased to the point where, in some cities, permits to construct new airports have been withheld and tight restrictions on aircraft operations have been imposed.

Attempts by civil authorities to minimize disturbances have taken many forms, including a limitation on night operations at some airports. At Morristown, New Jersey, for example, a state court judge recently ruled that no jet aircraft can land or depart from the city airport between 9 p.m. and 7 a.m. Monday through Saturday; on Sundays plane movements are even more restricted.[7] At National Airport in Washington, D. C., no planes may be operated between 11 p.m. and 7 a.m.[8] While such actions are effective in stopping aircraft-generated noise, they also produce negative economic impacts. According to the Department of Transportation, these airports can lose up to 20 percent of their capacity under such conditions.

Aircraft are a major source of noise pollution.

Many current technological efforts in noise abatement research originated under the direction of the Jet Aircraft Noise Panel, an ad hoc group formed by the White House Office of Science and Technology in 1965.[9] Following the recommendations of this panel, the FAA introduced regulations aimed at reducing aircraft noise; in addition, an Interagency Aircraft Noise Abatement Program was established under the joint leadership of the Department of Transportation and NASA. These initiatives have provided the stimulus to conduct major aircraft noise abatement studies. In one recent civil aviation study, conducted jointly by DOT and NASA, social as well as technical considerations in air transport were investigated. Aircraft noise abatement was given the highest priority, not only for the general public and the environment, but also because it is a key restraint to future aviation growth.

Noise abatement is a critical issue in air transportation.

As the civilian agency charged with aeronautical R&D responsibility, NASA has set its sights high for aircraft noise reduction.[10] The NASA Quiet Engine Program is serving as the technical focal point for U. S. work on noise reduction of subsonic jet aircraft. Researchers at NASA's Lewis Research Center and General Electric's Evandale, Ohio facility indicate that the "quiet engine" will meet and probably exceed its original noise reduction goals. At the reduced noise levels, a jet engine would create about as much noise as that heard on a busy metropolitan street. An unexpected benefit from this research indicates that these engines will also have superior performance characteristics including reduced fuel consumption. To facilitate other NASA noise pollution research work, a general purpose aircraft noise reduction laboratory is under construction at the Langley Research Center in Hampton, Virginia for studies of flow-induced noise and human response to noise.

NASA's Quiet Engine Program is vital.

NASA is by no means the only organization conducting jet engine noise research. Engineers and scientists throughout the world are turning to fundamental research in sound generation and noise abatement to construct a more solid basis for future advances in noise reduction.[11] Rolls-Royce, for instance, is using a special noise research facility at Anstey, near Coventry, England for a series of tests funded by the British Ministry of Technology; this year's expense will total about $215 million.

Noise research is world-wide.

United Aircraft Research Laboratories is building a noise research facility at East Hartford, Connecticut in which it will attempt to learn the fundamental nature of sound generation in turbine engines. General Electric is pursuing a similar goal at its Central Research and Engineering Laboratories in Schenectady, New York.

While such studies offer great promise for a quieter environment in the future, other research has already provided some relief.[12] One method for reducing community noise is based on research that was conducted at the NASA Ames Research Center.[13] The method reduced community noise approximately 50 percent by keeping an incoming airplane further from the ground for a longer period of time and permitting the final descent to be made at reduced thrust. One West Coast airline has incorporated the procedure for landing under visual flight rules at major airports like Los Angeles International. NASA is initiating a follow-up program aimed at allowing an aircraft to follow a low-noise landing approach profile automatically.

Revised landing procedure reduces jet aircraft noise.

Another noise-reduction study, the NASA Langley Acoustic Nacelle Program, considered lining engine ducts with a sound-absorbing material. This technique has become one of the most effective methods of jet engine noise attenuation discovered to date. Nacelle treatment is one of the main reasons the newly-introduced DC-10 aircraft is quieter, in spite of its large size, than most commercial planes now in service; only the DC-9, which is approximately one-fourth the certified gross weight of a DC-10, is quieter, and then only during takeoff.

Acoustic materials attenuate engine noise.

Easing Congestion

To motorists creeping ahead in rush-hour traffic along freeways and expressways designed to speed traffic through the nation's largest cities, it can be frustrating to watch jet airplanes race across the sky at 600 miles per hour. Ironically, the airline passenger often is similarly frustrated as he approaches his destination only to circle over a crowded airport and then wait on the ground for an open gate area and luggage just before being thrust into a traffic jam on a crowded highway.

The rush to wait is frustrating.

The problems manifested in these scenes illustrate the almost startling growth of transportation in the U. S. during the last twenty years. Growth has occurred primarily in the areas of air and highway travel between cities as jet airways and interstate highways have been criscrossed all over America. At the same time, however, the convenience and popularity of transit systems within cities have declined sharply. While travelers can move from city to city with unprecedented speed and ease, inside the cities decrepit mass transit systems and congested traffic threaten to cancel out the progress that air and highway programs have helped produce.

Better balance is needed.

For years, the response to growing congestion was to build more highways and bigger airports. Consider highway development, for example. The National System of Interstate and Defense Highways, started in 1956 and scheduled for completion late in the 1970's, will carry twenty percent of this country's highway traffic over a 42,500-mile nationwide network of controlled access freeways.[14] While the record shows that travel on interstate highways is faster and safer, the fact is that many urban highways become clogged the moment they are completed. During the 1960's, it became obvious that highway development was only one part of a vastly complex system for transportation and that a more balanced development was required. The creation of the Urban Mass Transit Administration in 1964 and the Department of Transportation in 1966 endorsed the "total system" approach to transportation development in this country. In the short span of less than a decade, the way of speaking about transportation has changed drastically. While traditional designations such as air, water, and ground travel still have their place, transportation experts are more inclined to talk about corridors, vehicles, terminals, communications and flow control along with service to people, private financing and environmental enhancement.

A systems approach can provide needed balance.

Many of the new challenges of transportation have technological underpinnings similar to those of the space program. In Morgantown, West Virginia, for example, the Boeing Company is developing the Personal Rapid Transit (PRT) System.[15] This "people mover" is providing rapid nonstop transit for individual passengers in computer-controlled cars. In developing the PRT, Boeing has employed many technologies that had their origins in or were significantly advanced by the civilian aerospace program, including systems safety, reliability and maintainability analysis along with complex control system design techniques. United Aircraft, another NASA contractor, has built two high-speed, gas turbine powered trains for service between New York and Boston.[16] The Atomics International Laboratories of North American Rockwell Corporation is working with the Southern California Rapid Transit District to develop and demonstrate a diesel exhaust emission control system to eliminate smoke and odor and substantially reduce noise.[17] The Bendix Corporation is prime contractor for the Columbia Transit Program, which will supply an integrated transit system for the new, planned city of Columbia,

Many aerospace firms are managing the development of rapid transit systems.

Maryland now under construction. The list of aerospace contractors involved in the development of ground transportation systems is quite long.[18] Dr. William J. Ronan, Chairman of New York's Metropolitan Transit Authority, struck at the heart of the issue when he stated that not only has price competition been introduced, but so also has technological competition.[19] This latter element is vitally important in view of the fact that the long-haul passenger car business, until a few years ago, was in the final stages of terminal disease.

One response to the expected 300 percent growth in intercity air traffic during the coming decade is simply to build more airports. As many airport planners are finding out, however, expensive real estate along with political opposition from taxpayers and suburbanites who don't want a jetport for a neighbor make new airport construction highly problematic. The ultimate challenge is to utilize existing airports more effectively and to develop smaller specialized facilities at other locations. For this effort, short take-off and landing (STOL) aircraft offer a less expensive solution. The fundamental advantage of a STOL system is that it allows separation of short-haul traffic from long-haul traffic. STOL ports could be shoehorned into cities and surrounding suburbs, thereby making existing jet terminals adequate for some time to come, plus shortening door-to-door travel time.

STOL aircraft promises to relieve air congestion.

NASA is providing the technical leadership and focus for STOL research in this country.[20] In recently announcing its $100 million program, the Agency stated its goal of providing the technical base needed to build practical STOL aircraft for civilian and military applications. Research is being conducted at several NASA facilities. Both Ames and Langley Research Centers, for example, are performing wind tunnel tests; Lewis Research Center is working on powerplant development and noise reduction; and NASA's Flight Research Center will conduct flight research operations. Joining NASA in this country's overall STOL research and development effort are DOT, the Air Force, most airframe manufacturers, and several hundred major equipment contractors.

NASA's STOL research program is underway.

Aviation Safety

Few would deny that the safety record of aviation has been excellent; however, it is far from perfect. While the accident rate for commercial aviation has always been quite low, just the opposite is true for general aviation.[21] Federal Aviation Agency statistics show that it is approximately ten times safer to fly in commercial rather than general aviation aircraft in terms of the potential for fatal accidents per trip.

Commercial aviation is much safer than general aviation.

General aviation's accident record is becoming an increasingly weighty component of the total air safety picture.[22] For every commercial aircraft now in service, there are approximately 50 general aviation craft; for every commercial transport pilot, there are a dozen noncommercial pilots; for every vehicle-mile flown by a commercial transport, general aviation flies two. Flight safety, therefore, can no longer be considered merely in terms of the excellent safety record of the commercial airlines, or the load which they place on airways management.

General aviation is an important component of the aviation picture.

The National Transportation Safety Board, the Federal Aviation Administration, NASA, and the Air Force have been working hard to reduce aviation accidents--both general and commercial. Specifically, these agencies have made considerable progress in preventing accidents involving turbulence, congestion and slippery runways.

Federal agencies are working to neutralize aviation hazards.

Since 1964 well over 100 accidents have resulted when smaller aircraft encountered the violent corkscrew-like air currents generated by the wing tips of large transport airplanes.[23] NASA's Flight and Ames research centers, in conjunction with the Federal Aviation Agency's Western Regional Office, have conducted several studies on this "wake turbulence" which often renders a light aircraft uncontrollable.[24] The results of these studies have already helped avert disasters by providing air traffic controllers with criteria for minimum separation distances between various aircraft, as well as advising pilots on corrective measures that can be taken after encountering these invisible hazards. Flight Research Center engineers also have developed flight control mechanisms that have helped improve the safety of general aviation aircraft.

NASA and FAA have determined minimum safe distances between various aircraft.

In cooperation with the Federal Aviation Agency, NASA is conducting work on pilot warning indicators to help prevent midair collisions. One program involves the use of bright flashing lights and electronic detectors. The lights emit not only a brilliant visible flash but also infrared energy that can be picked up by a detector, which in turn alerts the pilot. Another system uses radar to detect the presence of nearby aircraft and warns a pilot of an impending midair collision.[25] The goal of these programs is to provide low-cost collision-avoidance instruments for both commercial and general aviation, thereby increasing the safety of air travelers.

NASA and FAA are developing better collision avoidance systems.

Building on research initiated by the British in the mid-1950's, NASA has worked with the Department of Transportation and other agencies to solve the problem of airplanes skidding off runways.[26] NASA's Langley Research Center has developed a variety of methods for grooving and otherwise roughening runways. Many airports throughout the

NASA and DOT have determined appropriate solutions to runway skid problems.

world are using these techniques. At Chicago's O'Hare International Airport, for example, nearly 10 million passengers benefited from the added safety of grooved runways last year.[27] During the same year, eight million passengers landed on the grooved runway at Kennedy International Airport in New York.[28] Airline pilots who have used these runways report them to be of distinct assistance in stopping and in maintaining runway alignment during inclement weather. In a survey of general aviation pilot reactions to grooved runways conducted by the Flight Safety Foundation, over 65 percent of the pilots surveyed said that grooving reduced hydroplaning and improved breaking.[29]

The Langley Research Center also has extended the pavement-grooving research to highways and it was found that grooved pavements reduce accidents considerably during wet weather. In a study conducted in California, it was found on several sections of highway in which a large number of accidents occurred during wet weather that grooving those sections resulted in approximately a 92 percent reduction in accidents. Curved sections of interstate highways throughout the country are now being grooved to increase driving safety.

As part of the nationwide effort to generate and provide greater access to aerospace-related safety information, NASA Lewis Research Center recently organized the Aerospace Safety Research and Data Institute (ASRDI).[30] ASRDI supports NASA, its contractors and the aerospace industry in general with technical information and consulting on safety problems; identifies areas where safety problems and technology voids exists and initiates research programs in those areas; publishes state-of-the-art publications in various areas related to aerospace safety; and operates a safety data bank as a resource to be used in solving aerospace safety problems.

Producing Needed Transportation Technology

Underpinning the current transportation revolution in this country is the technology flowing out of several national R&D programs. As in the past, research programs conducted at all NASA field centers and contracting firms will play a continuing role in the advancement of aviation. Yet NASA's influence will extend far beyond its own research sphere. The Transportation Systems Center (TSC) in Cambridge, Massachusetts, for example, was the NASA Electronics Research Center until 1970. Today, several hundred former NASA scientists and engineers at TSC are part of the team supplying the technology base in transportation system development for the challenges of the 1970's.[31]

To improve transportation, America is capitalizing on its technical momentum.

Utilizing the technology and capability established in measuring and improving the ride quality on aircraft and spacecraft, the NASA Langley Research Center (LRC) is providing consulting service to the DOT on ground transportation. Ride environment measurements were made and analyzed by the LRC on the Metroliner, Turbotrain, Rapido Train, Montreal Subway, automobiles and buses; in addition, a generalized multi degree-of-freedom computer program for suspension optimization has been developed. The LRC is providing consulting service on the Wheel Rail Dynamics

Laboratory at Pueblo, Colorado, as well as on the prelimianry design of the Track Air Cushion Research Vehicle (TACRV). Two well-known aerospace contractors, Wyle and Grumman, also are deeply involved in DOT's Pueblo Test Center. Wyle Laboratories is designing the Wheel/Rail Dynamics Laboratory. The Grumman Aerospace Corporation, designer and builder of the lunar excursion module, is conducting engineering design and development studies for the track Air Cushion Research Vehicle (TACRV). The TACRV will travel at 300 miles an hour and will be powered by virtually pollution-free, noiseless linear induction motors built by Garrett-AiResearch Corporation.

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